Foundation Initiative 2010
(FI 2010)

PM ITTS STOC Industry Conference

7-8 August 2001

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FI 2010 Background

- Provide the core products necessary to:
  - enable **interoperability** among ranges, facilities,and simulations in a quick, cost-efficient manner
  - foster **reuse** for range asset utilization and for future developments
- Supports the warfighter (Joint Vision 2020)
- Enables Simulation Based Acquisition (SBA) and Simulation Test and Evaluation Process (STEP)
- Fosters test and training integration
- Saves money in the long term
- Lays the foundation for future range instrumentation

Foundation Initiative 2010 Team

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Project Director

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IKE 2 Test

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IKE 2 User Guide

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TENA

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EPG

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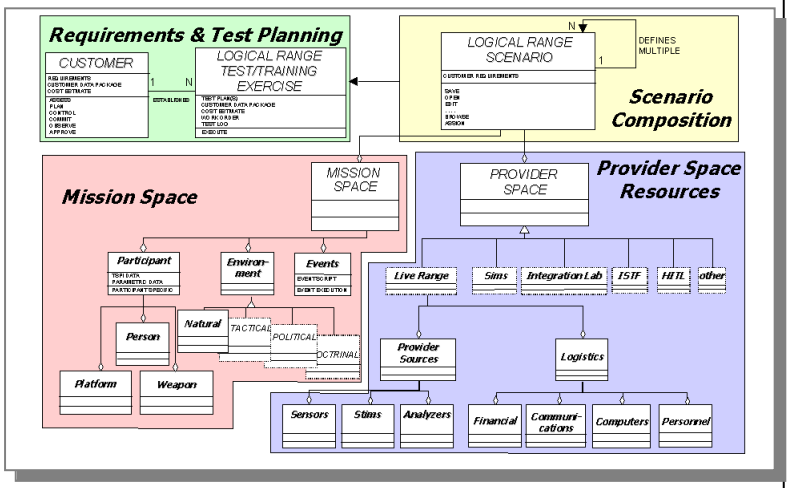
Development Test Cells

FI 2010
Program Description

- **Architecture**
  - Data Standards — TENA Object Model (data elements)
  - Data Transport Mechanism — TENA Services (middleware software)
- **Tools (software applications)**
  - Resource Manager (e.g., define and browse Range resource interface definitions)
  - Test / Exercise Planner (e.g., instrumentation optimization, “what-if” analysis)
  - Test / Exercise Manager (e.g., monitor & control test resources during a mission)
  - Test / Exercise Analyzer (e.g., data extraction, data reduction, statistical analysis)
- **Integration Products**
  - Selected resource interfaces
    - Range Instrumentation
    - Range Control Systems / Facilities
    - Tactical Systems
  - Validation of commercial communication systems (including encryption equipment)
  - Procedures & recommended practices (Developer’s & User’s Guides)

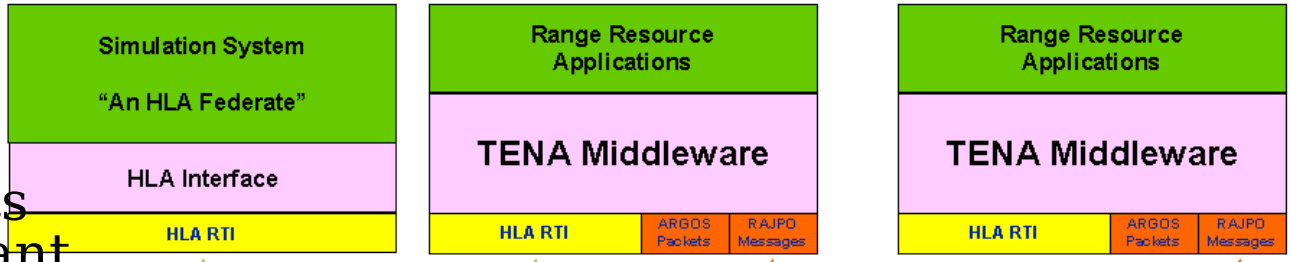
Test & Training Enabling Architecture (TENA)

- **Object Model**
  - Data Elements of Test / Exercise
    - System-under-Test / Training Participant
    - Range and Facility Resources
  - Includes Resource Functionality

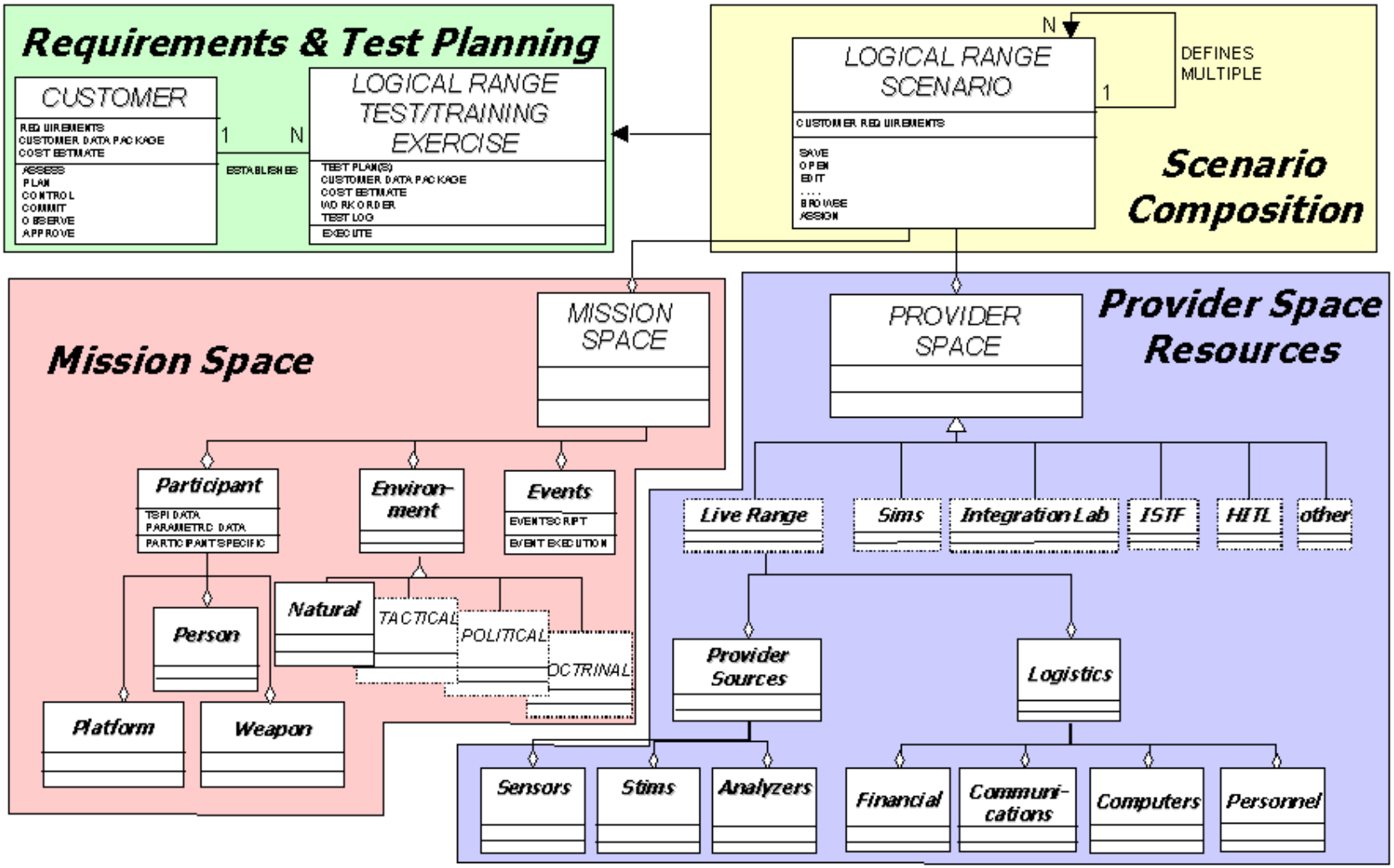


- **Services**
  - Specification for the way Test Resources interact & exchange data

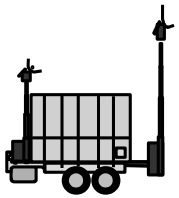
- **Rules**
  - Requirements to be compliant
  - Standards & Protocols



TENA Object Model

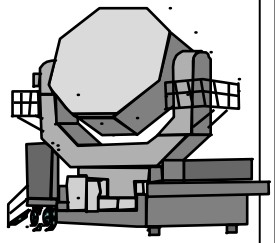


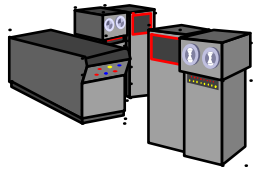
TENA Services
TENA Middleware



"Mission Space" Objects

"Provider Space" Objects





Test Resource Application Software

TENA Object Services

TENA Distribution Services

HLA Interface	IP Interface	TADL Interface	○○○	CORBA Interface
HLA RTI	Range Protocols	Tactical DataLink	○○○	CORBA

TENA Middleware

Standard API to manipulate Test Data

IMO

PM-ITTS

1st TENA Middleware Prototype (IKE 1)

- **Concept Exploration Prototype**
- **Basic Core Functionality (defined at CTTRA IX)**
  - Dynamically create objects
  - Discover modifications dynamically
  - HLA / TENA Interface
  - Existing Range Protocol / TENA Interface
- **Written in JAVA**
- **Developed in 1999 by NUWC**
- **Tested at 6 Ranges in 2000 (reported and reviewed at CTTRA X)**
  - AAC, Eglin AFB FL
  - NUWC, Newport RI
  - NAWC-AD, Pax River MD
  - WSMR, White Sands NM
  - RTTC, Huntsville AL
  - EPG, Fort Huachuca AZ
- **Deployed operationally by NUWC at a test range (AUTEC) and planned to be deployed operationally at a training range (SWTR)**

2nd TENA Middleware Prototype (IKE 2)

- **Goals**
  - Expanded Functionality / Finalization of the TENA Middleware API
  - Leverage experience of commercial software contractors
  - Maximize Range implementation
    - Significant Range input & testing (via Development Test Cells at the Ranges)
    - CTTRA Review and Assessment
    - Professional User Guides with examples
  - Support Weapon System Tests and Joint Experimentation
- **Design Philosophy**
  - Reuse design and lessons learned from HLA
  - Incorporate commercial, government, & open-source off-the-shelf products
    - CORBA / ACE & TAO
    - 1st TENA Middleware Prototype
  - Create and use Object-Oriented Frameworks
    - Generic yet flexible / Tailorable
- **Schedule**
  - Spiral/Iterative Development
  - First release Fall 2001 with subsequent releases every 7-9 months

2nd TENA Middleware Prototype
Requirements

- **Defining the TENA Object Model**
  - Defining the TENA Classes
  - Object Relationships
  - The TENA Interface Repository
  - Instantiating Objects
  - Atomic State Updates
  - Object Security
- **TENA-to-TENA Communications**
  - Mechanisms
    - Remote Method Invocation
    - Publication State Updates
    - Messages
    - Data Streams
    - Object Migration
  - Quality-of-Service
  - Subscription Services
  - Application Gateway (to legacy protocols)
- **TENA Exercise Management**
  - Barrier Synchronization
- **Support for:**
  - Multiple Threading Strategies
  - Multiple Processes
  - Internal Diagnostics
- **Non-Functional Requirements**
  - Security
  - Performance
  - Usability
  - **Support multiple languages and platforms**
- **Implementation**
  - Documentation/Help
  - Training
  - Testing

IKE 2 Release Functionality

Release 1 (Sept 2001)

- TENA Object Services
  - Object Instantiation
  - Object Composition & Relationships
  - Publication State Distribution
  - Data Integrity
  - Change Notification
  - Method Operations
- Interface Repository
- Multiple Platforms (Linux, Windows)

Release 2 (Dec 2001)

- TENA Object Services
  - Code generation support
- Built-In Diagnostics
  - Performance Metrics
- Gateway Support
  - Basic HLA gateway
- Multiple Languages
  - Java (* - evaluate need for r2)

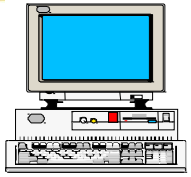
Release 3 (May 2002)

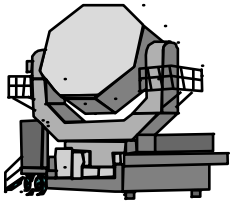
- TENA Object Services
  - Introspection
  - Ownership Management
- Messages and Data Streams
- Gateway Support
- Data Logging Support

Release 4 (Nov 2002)

- Access Control
- Security
- Additional Platforms (e.g., VxWorks)

TENA Architectural Construct with FI 2010 Tools





HWIL

Non-TENA System

Non-TENA System

Non-TENA Communication

Range Resource

Range Resource

Range Resource

TENA Gateway

TENA Interface Repository

TENA Middleware

Test / Exercise Data Archive

Test / Exercise Planner

Test / Exercise Manager

Data Collector

Resource Manager

Test / Exercise Analyzer

FI 2010 Tools

Development Test Cells

A set of computer systems that are configured to serve as a Range surrogate
  – Operated by Range personnel

- **Benefits**
  FI 2010
    - Our customers (Ranges) test our products early in development
    - Insight to product performance in Range environment

  Ranges
    - Understanding of FI 2010 Products
    - Better able to articulate issues & concerns to influence development

- **Beta test sites for TENA Services & Tools**
- **Implements TENA at the DoD Ranges & Facilities**
- **Propagates TENA solution across Ranges to support testing advanced weapon systems**

DTCs Locations

FY98	FY99	FY00	FY01	FY02	FY03	FY04
AAC (Eglin) **NUWC** **NAWC-AD**	**WSMR** **RTTC**	EPG	**NAWC-WD** **(China Lake &** Point Mugu)	**AFFTC** **ATC**	**Fort Hood** **YPG**	
			Nellis* **PMRF***	**Army CTCs***		

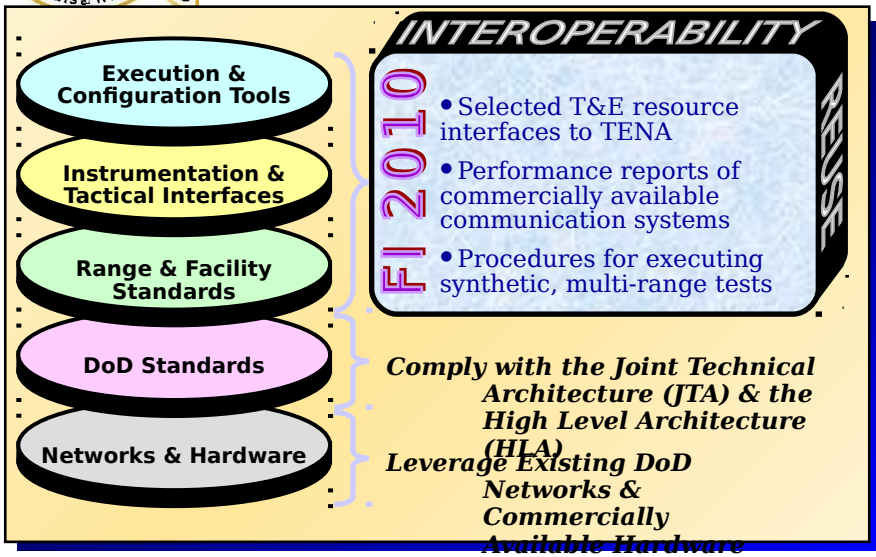
Architecture Management Team (TENA AMT)

- **System Engineers & Technical Leads for the current major stakeholders of TENA**
  - AAC, Eglin AFB FL
  - NUWC, Newport RI
  - NAWC-AD, Pax River MD
  - WSMR, White Sands NM
  - RTTC, Huntsville AL
  - EPG, Fort Huachuca AZ
  - NAWC-WD, China Lake & Point Mugu CA
  - Virtual Proving Ground (VPG)
  - Common Training Instrumentation Architecture (CTIA)
  - PMRF Synthetic Range

Meetings every 4-6 weeks

- **Design Decisions / Trade-offs / Status**
- **TENA Use Cases / Prototype Test Strategies**
- **Technical Exchanges of Lessons Learned**
- **Issues & Concerns Identification, Investigation, & Resolution**

FI 2010
Program Description


Execution & Configuration Tools
Instrumentation & Tactical Interfaces
Range & Facility Standards
DoD Standards
Networks & Hardware
INTEROPERABILITY
FI 2010
• Selected T&E resource interfaces to TENA
• Performance reports of commercially available communication systems
• Procedures for executing synthetic, multi-range tests
REUSE
Comply with the Joint Technical Architecture (JTA) & the High Level Architecture (HLA)
Leverage Existing DoD Networks & Commercially Available Hardware

USERS / CUSTOMERS

- MRTFBs
- JFCOM
- Unmanned Air Vehicle (Air Force)
- Joint Strike Fighter (Joint Service)
- PM Javelin / RTTC (Army)
- Roving Sands (Joint Service)
- PM Comanche (Army)
- Virtual Proving Ground (Army)
- CVN - 76 (Navy)
- DD - 21 (Navy)

DESCRIPTION

- Developing and validating products necessary to enable interoperability among ranges, facilities, and simulations to create synthetic battle-spaces consisting of actual weapon systems at multiple ranges, system components in hardware-in-the-loop facilities, and/or simulations of weapon systems.
- Strategy includes -
  - Establishing Development Test Cells
  - Establishing TENA as the Range Commander's Council architecture standard
  - Developing TENA middleware using rapid prototyping approach

FUNCTIONAL DATA

- FI2010 Core Products include –
  - A common architecture
  - A core set of tools
  - Inter-range communication capabilities
  - Interfaces to existing range assets
  - TENA interfaces for tactical systems
  - Recommended procedures for

Acquisition/Contracting

Strategy

- Establishing Development Test Cells (DTC) to test/validate/verify TENA architecture
- Awarding contracts for a specific task (IKE 2, IKE 3, Tools)

Rationale

- Taking a System Engineering approach using expertise within various government agencies
- No single, overarching, turn-key contract

IKE 3 Functionality

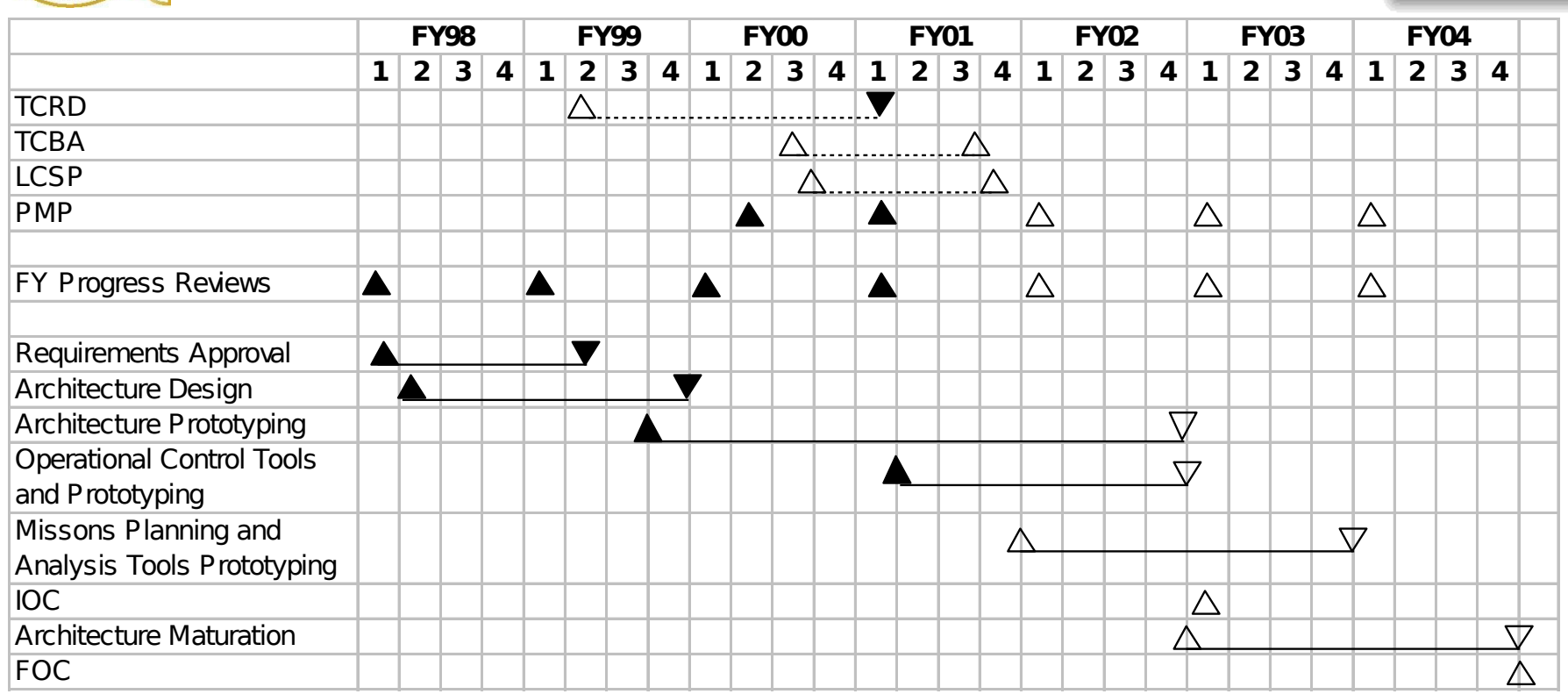
Goals and Objectives:

- Increase performance
- Increase integration with persistent storage mechanisms
- Expand common object model
- Increase complexity of logical ranges being tested
- Increase support for the integration of legacy systems

Tools Schedule

Tools	FY01	FY02	FY03	FY04
Resource Manager	Object Model Definition	Compatibility Checker Configuration Reconfiguration Local Com Service Definitions	Local Repository Browser Compliance Track Test / Verify Perf. Other Com Service Def. (I.e. DREN)	External Repository Browser Usage Tracking Plug & Play
Test/Exercise Planner		Scenario Design Variable Speed Simulation Safety Analysis Network Performance Local Resource Selection	Instrumentation Configure Test Plan Generation External Resource Selection UUT Performance Model Pre-test Check-out	Instrumentation Optimization What-if-analysis Commercial Network Optimization Network Scheduling
Test/Exercise Manager	Exercise Monitoring Resource Status	2-D / 3-D visualization Multi-level Time Sync Scenario Control Display Flex.	Network Set-up Network Monitor Data Management Multi Perspective Display Test Plan Import	Real time Test Reconfiguration Interoperable w/other Managers Resource & Scenario State
Test/Exercise Analyzer		Data Import Statistical Analysis Test Playback	Actual vs. Sim. Comparison Multi-speed Analysis	Full Test Rebuild w/Planner - Manager

FI 2010
Program Schedule/Funding



	Fiscal Year						
in millions $	PRIOR	1999	2000	2001	2002	2003	Complete
Total Requirement	$	$$	$$	$$$	$$$	$$$	$$
CTEIP Funded	$	$$	$$	$$$	$$$	$$$	

IMO

PM-ITTS

Summary

- FI 2010 serves to acquire the necessary products for interoperability and reuse among ranges, facilities, and simulations
- TENA is being developed with a “rapid prototyping” strategy using the spiral development process
- Supporting major acquisition initiatives (JSF, JFCOM, Comanche, CTIA, JDEP, etc.)
- 2nd middleware (IKE 2) prototype currently under development with SAIC (Alexandria, VA.)
- Tools tasks will commence in FY 02
- 3rd prototype (IKE 3) will be awarded in FY 03
- For more information, visit http://FI2010.jcs.mil

Acronyms

AAC	Air Armament Center		JSF	Joint Strike Fighter
ACE	Adaptive Communication Environment		LCSP	Life Cycle Support Plan
API	Application Programmer Interface		MRTFB	Major Range & Test Facility Base
ATC	Aberdeen Test Center		NAWC-AD	Naval Air Warfare Center - Aircraft Division
AUTEC	Atlantic Undersea Test & Evaluation Center		NAWC-WD	Naval Air Warfare Center - Weapons Division
CORBA	Common Object Request Broker Architecture		NUWC	Naval Undersea Warfare Center
CTC	Combat Training Center		PMP	Project Management Plan
CTIA	Common Training Instrumentation Architecture		RTI	Run Time Infrastructure
CTTRA	Common Test and Training Range Architecture		RTTC	Redstone Technical Test Center
DTC	Development Test Cell		SBA	Simulation Based Acquisition
EPG	Electronic Proving Ground		STEP	Simulation Test & Evaluation Process
FI 2010	Foundation Initiative 2010		SWTR	Shallow Water Training Range
FOC	Full Operational Capability		TADL	Tactical Data Link
HLA	High Level Architecture		TAO	The ACE ORB
IKE 2	2nd TENA Middleware Prototype		TCBA	Test Cost Baseline Analysis
IOC	Initial Operational Capability		TCRD	Test Capabilities Requirements Document
IP	Internet Protocol		TENA	Test & Training ENabling Architecture
JDEP	Joint Distributed Engineering Plant		WSMR	White Sands Missile Range
JFCOM	Joint Forces Command		YPG	Yuma Proving Ground